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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Marco Macchetti

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11/27/2006

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EXAMINER

COLIN, CARL G

ART UNIT

PAPER NUMBER

2136

DATE MAILED: 11/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/974,705

Applicant(s)

MACCHETTI ET AL.

Examiner

Carl Colin

Art Unit

2136

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 07 September 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 21-47 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 21-47 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Response to Arguments***

1. In response to communications filed on 9/7/2006, applicant amends claims 21, 25, 31, and 44, the following claims 21-47 are presented for examination.

1.1 In response to communications filed on 9/7/2006, the 112<sup>th</sup> rejection with respect to claim 25 has been withdrawn.

1.2 Applicant's remarks, filed on 9/7/2006, with respect to the rejection of claims 21-47 have been fully considered and they are persuasive as amended. Applicant has amended the independent claims to recite exchanging each of the rows with a respective column to replace transposing each of the rows and columns. Upon further consideration, new grounds of rejection are made and claims 21-47 are now rejected in view of Ohkuma et al and Luther.

### ***Claim Rejections - 35 USC § 101***

2. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 21-47 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. The claimed invention as a whole must accomplish a practical application and must produce a useful, concrete, and tangible result. For instance, claim 21 is

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directed to a method of converting data between an unencrypted format and an encrypted format (preamble). However, the claim limitations only refer to manipulation of mathematical algorithm or calculations and do not recite any conversion from unencrypted to encrypted format or vice versa. Also, there is no key being applied so that the end result is an encryption or decryption result as stated in the preamble. Independent claims 31 and 44 although they recite a device, the claims seem to be directed to an abstract idea without limitation to a practical application (i.e. the claims do not result in a useful concrete and tangible result). No data, output or result have been produced through the steps of performing and exchanging, nor data to be converted between an unencrypted format and an encrypted format as stated in the preamble.

### ***Claim Rejections - 35 USC § 112***

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 21-25 and 31-43 are rejected under 35 U.S.C. 112, first paragraph, as based on a disclosure which is not enabling. Applying “a key” is critical or essential to the practice of the invention, but not included in the claim(s) is not enabled by the disclosure. See *In re Mayhew*, 527 F.2d 1229, 188 USPQ 356 (CCPA 1976). Applicant’s abstract states that in the invention data are converted... according to the Rijndael algorithm and the specification page 6, lines 32-33 recite “to operate properly the Rijndael algorithm needs a key”. The invention as disclosed in the claims above have an essential or critical element missing to the practice of the invention.

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claims 21-47** are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent Publication US 2001/0024502 to **Ohkuma et al** in view of US Patent 5,533,127 to **Luther**.

**As per claim 21, Ohkuma et al** substantially teaches a method for converting data between an unencrypted format and an encrypted format, the data being organized in bit words, the method comprising: *performing a plurality of transformation rounds* (see paragraph 92), *applying at least one transformation to a two-dimensional array of rows and columns of bit words defining a state array* (page 12, paragraphs 272-274 and figure 30), and **Ohkuma et al** discloses that a matrix obtained by substituting rows and substituting columns and transposing the rows and columns in another matrix (state array) may be used (paragraph 268) . As interpreted by examiner the transposing is performed by substituting rows and substituting

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columns to obtain a transposed MDS matrix (state array) for instance, in figure 31, to obtain y, a transformation is performed to obtain a transposed state of the matrix (paragraph 270 states executing transformation by means of a matrix) therefore, **Ohkuma et al** discloses transposing each of the *rows and columns of the state array to form a transposed state array for at least one of the transformation rounds so that at least one transformation is applied to the transposed state array* (see paragraphs 261-271 see figure 30). **Ohkuma et al** does not explicitly disclose *exchanging each row with a respective column of the state array to form a transposed state array*. **Luther** in an analogous art discloses an encryption system for two-dimensional binary data using a plurality of rounds or passes. In each pass each row and each column of binary data is encrypted (see column 1, lines 35-39). In one embodiment, **Luther** suggests that during the process of encryption, in complementing the data signals in the rows and the columns respectively, a substitution of a swap row/column could be implemented to further confuse the data (see column 6, lines 12-16). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of **Ohkuma et al** to perform *exchanging each row with a respective column of the state array to form a transposed state array* to further confuse the data as suggested by **Luther**. One of ordinary skill in the art would have been motivated to do so because it would add another layer of security by hiding the data used in the process of encryption therefore it would be harder for an attacker to be successful in a cryptanalysis attack since the exchanging of row/column is added to confuse the data as suggested by **Luther** (see column 6, lines 12-16).

As per claim 31, **Ohkuma et al** substantially teaches a device for converting data between an unencrypted format and an encrypted format, the device comprising: at least one register for storing the data in the form of bit words (see figure 10); and a circuit for *performing a plurality of transformation rounds* (see paragraph 92), *applying at least one transformation to a two-dimensional array of rows and columns of bit words defining a state array* (page 12, paragraphs 272-274 and figure 30), and **Ohkuma et al** discloses that a matrix obtained by substituting rows and substituting columns and transposing the rows and columns in another matrix (state array) may be used (paragraph 268). As interpreted by examiner the transposing is performed by substituting rows and substituting columns to obtain a transposed MDS matrix (state array) for instance, in figure 31, to obtain y, a transformation is performed to obtain a transposed state of the matrix (paragraph 270 states executing transformation by means of a matrix) therefore, **Ohkuma et al** discloses transposing each of the *rows and columns of the state array to form a transposed state array for at least one of the transformation rounds so that at least one transformation is applied to the transposed state array* (see paragraphs 261-271 see figure 30). **Ohkuma et al** does not explicitly disclose *exchanging each row with a respective column of the state array to form a transposed state array*. **Luther** in an analogous art discloses an encryption system for two-dimensional binary data using a plurality of rounds or passes. In each pass each row and each column of binary data is encrypted (see column 1, lines 35-39). In one embodiment, **Luther** suggests that during the process of encryption, in complementing the data signals in the rows and the columns respectively, a substitution of a swap row/column could be implemented to further confuse the data (see column 6, lines 12-16). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the

method of **Ohkuma et al** to perform *exchanging each row with a respective column of the state array to form a transposed state array* to further confuse the data as suggested by **Luther**. One of ordinary skill in the art would have been motivated to do so because it would add another layer of security by hiding the data used in the process of encryption therefore it would be harder for an attacker to be successful in a cryptanalysis attack since the exchanging of row/column is added to confuse the data as suggested by **Luther** (see column 6, lines 12-16).

As per claims 22 and 32, the references as combined above disclose the limitation of *wherein said at least one register stores bit words as 8-bit words* (**Ohkuma et al**, page 6, paragraph 128).

As per claims 23 and 33, the references as combined above disclose the limitation of *wherein said circuit operates on a state array comprising a 4x4 matrix of bit words* (**Ohkuma et al**, page 6, paragraph 128).

As per claims 24 and 34, the references as combined above disclose *said circuit in performing a plurality of transformation rounds performs at least 10 transformation rounds* (**Ohkuma et al**, page 4, paragraph 92).

As per claim 25, the references as combined above disclose *performing at least one stage or round on a non-transposed matrix* (state array); (see **Ohkuma et al**, paragraph 241) stating “the final round does not include any higher-level MDS”. Performing at least one round



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on a non-transposed state array is well known as disclosed in Rijndael cipher algorithm. (See also **Ohkuma et al**, page 4, paragraph 87, and prior art figure 4 of Applicant's disclosure).

**As per claim 26**, the references as combined above disclose *applying at least one round key to the state array in at least one of the transformation rounds* (see **Ohkuma et al**, paragraphs 310-311 and 319).

**As per claim 27**, the references as combined above disclose the limitation of *wherein the at least one round key is transposed* (see **Ohkuma et al**, figure 3 and figure 6 and page 5, paragraph 109).

**As per claim 28** the references as combined above disclose the limitation of *adding code to transpose the at least one round key* (see **Ohkuma et al**, page 6, paragraphs 140-142; see also page 7, paragraph 147).

**As per claim 29**, the references as combined above disclose the limitation of *wherein the at least one round key comprises a plurality of round keys, each corresponding to a respective transformation round and being applied according to a round key schedule* (see **Ohkuma et al**, page 7, paragraph 147).

**As per claim 30**, the references as combined above disclose the limitation of *wherein the round key schedule comprises a transposed round key schedule* (see **Ohkuma et al**, page 7,

paragraph 147). The transformation applied to the round key schedule by diffusing random keys and applied different constants at different units of rounds meets the recitation of a transposed round key schedule.

**As per claim 44**, independent claim 44 recites the same limitations as found in claim 31 and further adds the limitation in claim 26. Claim 44 is therefore rejected on the same rationale as the rejection of claims 31 and 26 above.

**As per claims 35 and 45**, the references as combined above disclose *wherein said circuit comprises at least one S-box processing module, said at least one S-box processing module operating on a group of bit words defining a cell of a column of the state array* (see **Ohkuma et al**, figure 6, 112).

**As per claim 36**, the references as combined above disclose *wherein the at least one S-box processing module comprises a plurality of S-box modules, each of the plurality of S-box modules operating on a corresponding cell of a column of the state array* (see **Ohkuma et al**, figure 6, 112).

**As per claim 37**, the references as combined above disclose the limitation of *wherein the column of the state array comprises four cells* (**Ohkuma et al**, page 4, paragraph 92).

As per claims 38-39 and 46-47, the references as combined above disclose that the invention can be performed by any number of modules and any combination of bits wherein the circuit further comprises a plurality of shift column modules, (**Ohkuma et al**, page 3, paragraphs 62-65); and further discloses shift up can be performed (**Ohkuma et al**, page 5, paragraph 117); column mix is also a well known process as disclosed in Rijndael cipher algorithm (**Ohkuma et al**, page 1, paragraph 5 and page 4, paragraph 87) that meets the recitation of *each of said plurality of shift column modules to perform a column shift operation on a column of the state array* and the limitation of *wherein a column shift operation performed by each of said plurality of shift column modules generates shift column data, and wherein said circuit further comprises a single mix column module to perform column mix operations on shift column data.*

As per claims 40-43, the references as combined above disclose an encryption and decryption apparatus that meets the recitation of *encoder* for converting data from an unencrypted data format to an encrypted data format and a *decoder* for converting data from an encrypted data format to an unencrypted data format (**Ohkuma et al**, page 15, paragraph 343-349). **Ohkuma et al** further discloses an encryption and decryption apparatus formed as a semiconductor device that meets the recitation of *embedded system for use in a smart card* (**Ohkuma et al**, page 15, paragraph 343-349).

***Conclusion***

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Carl Colin whose telephone number is 571-272-3862. The examiner can normally be reached on 8:00-6:30.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nasser G. Moazzami can be reached on 571-272-4195. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

cc

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Patent Examiner  
November 20, 2006

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11/20/06